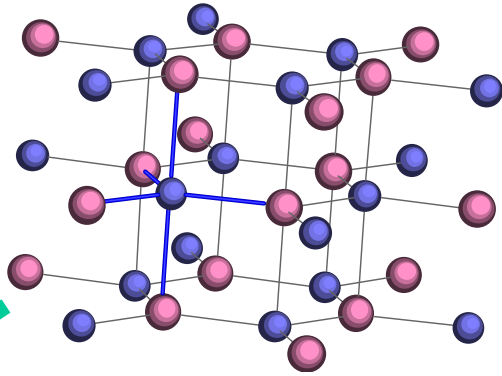
FRG : Origin of the Spin-Relaxation Lifetime on a Nanometer-Scale for Metal-Semiconductor Interfaces : A Combined Theoretical and Experimental Approach

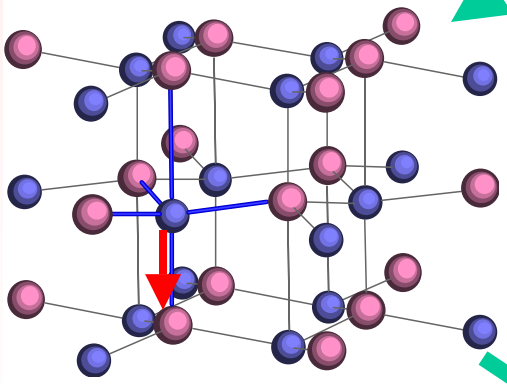
P.M. Thibado, L. Bellaiche, V.P. LaBella, W.F. Oliver, Arkansas , DMR-0102755.

Semiconductors are increasingly used for light emitting devices. On the other hand ferroelectrics display huge piezoelectric response and hence find application in ultrasonic and sonar listening devices based on an efficient conversion between electrical and mechanical signals. The vision for the new materials technology is to design "*smart materials*" which are "*multifunctional*". Based on our first-principles calculations we predict that under tensile strain ScN will not only emit light in the entire visible spectrum, it also demonstrates an electro-mechanical response much stronger than the perovskites - the fodder for piezoelectric industry.

V. Ranjan *et al.*, Phys Rev. Lett. 90, 257602 (2003).

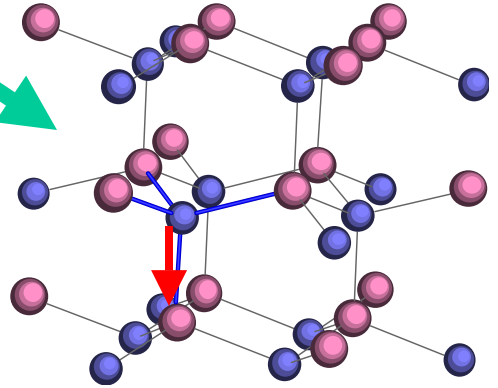
Equilibrium hexagonal ScN. Sc atoms are represented by violet dots and Nitrogen (N) by blue dots.





When strain is applied, N-plane develops small displacement with respect to Sc-plane. This is a group -subgroup transition which leads to strong piezoelectricity.

As the strain is increased the 5-times coordinated hexagonal layered system transforms to a 4-times coordinated wurtzite structure. A large variation of band gap is observed.



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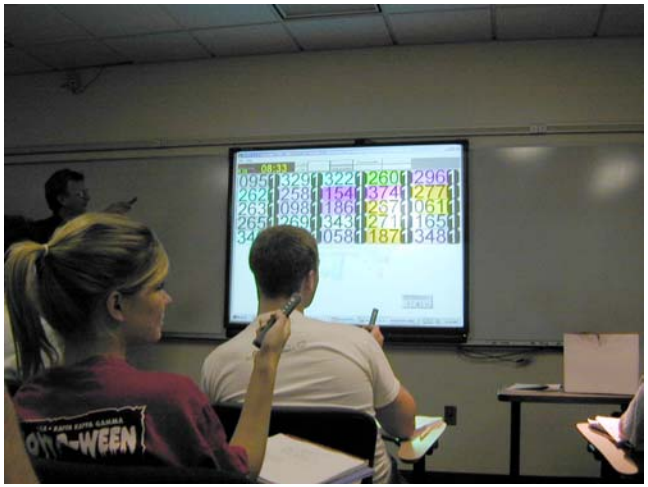
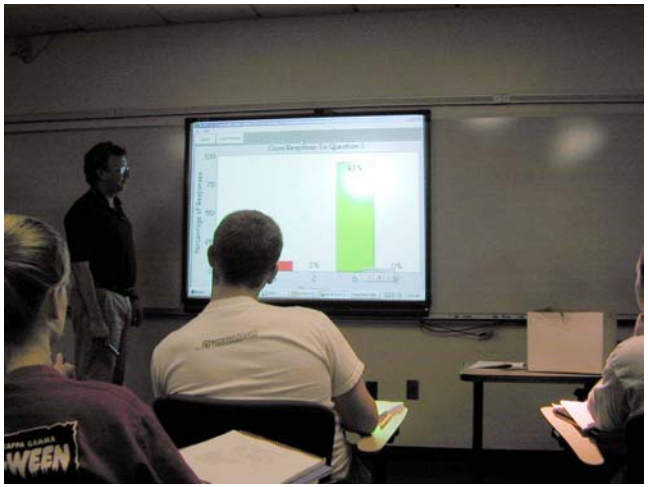
Promoting an active environment for learning science was found to be key in our program.

Here students are answering multiple choice questions using personalized transmitters. Their answers are digitally collected and graded. A histogram shows the distribution of responses.

With only a small amount of class time, the instructor and students get immediate feedback on whether or not the lecture is run at the correct pace.





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Education:
One undergraduate student, two graduate students, one postdoctoral fellow and Eric J. Walter from College of Williams and Mary, Williamsburg, Virginia, contributed to this work.

Vivek Ranjan at the Northwest Arkansas Mall judging for the boosting engineering, science, and technology (BEST) competitions.

Outreach:
The postdoctoral fellow Vivek Ranjan participated as *judging volunteer* for the Northwest Arkansas (NWA) BEST competition (www.bestinc.org). NWA BEST is a group of industrial, educational and business volunteers in Northwest Arkansas to inspire and motivate high school students towards studies and careers in engineering, science, technology through the use of a sport-like technology contest.